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Design for sustainability and project management literature – a review

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Abstract

The growing pressure on natural resources and increasing global trade have made sustainability issues a prime area of concern for all businesses alike. The increased focus on sustainability has impacted the way projects are conceived, planned, executed and evaluated in industries. Since project management literature has hardly been considered in design for sustainability research, this article attempts to review the points of intersection between these two fields, and explores the potential that knowledge from project management literature has in improving efficiency and effectiveness of development and implementation of design for sustainability tools.

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Keywords: Design for sustainability; project management; product development; ecodesign

1. Introduction

The last few decades have witnessed increasing interest and attention for sustainability issues, and companies and industry branches around the globe increasingly see this as an opportunity to seize the potential business behind sustainability initiatives. Searching for ways to introduce and implement design for sustainability within industry has been one of the primary responses from the academia; and this has been mainly done in the form of method and tool development. However, research on the industrial state-of-the-art, both older [1]–[3] and more recent [4], [5], suggests that the application of these tools is marred by low degrees of implementation of design for sustainability (DfS) tools in "real life" industry [6].

An evident change brought about by the focus on sustainability is the change from product based systems to the product-service based systems [7]. Further, earlier works by Johansson [8] and van Hemel and Cramer [9] also highlight the need for internal stimuli in the form of innovation possibility, competence building within the company, customer relationship, management commitment etc. as some of the major success factors for successful integration of DfS in industry. More recently, Brones et al. [10] observe that these changes, among others, have necessitated research to explore the need for an overview of the various activities associated with DfS in the industry. Further, the need to have a holistic approach by considering various elements of design of sustainability as part of a single system has also been argued for in the environment friendly design context [11], [12]. The need to factor for increasing organisational complexities and importance of communication at different stages of eco-design product development [13], [14] also highlight the need for a project based approach to the topic of DfS. For the purpose of this research work, DfS is defined as the product design and development process with careful consideration of relevant aspects that can mitigate many environmental, societal and economic challenges during the life cycle of the product [15].

Stressing upon the need for project management in the sustainable development context, Labuschagne and Brent [16] observe that project management, being the "core business methodology" of most companies, cannot be excluded from the discussion on sustainability. It is in this context that this article explores the applicability and presence of project management focus in the existing DfS literature. Literature on project

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management practices and knowledge has been diverse and vivid. Among these academic works, the Project Management Body of Knowledge (PMBoK) issued by the Project Management Institute (PMI) has been widely used as the basis for various terminologies and guidelines in industries. Subsequently, this research work also uses PMBoK as a reference for the analysis on project management practices and terminologies. For the purpose of research and analysis, the following definition of project management from the PMBoK (4th Edition) is used:

"Project management is the application of knowledge, skill, tools and techniques to project activities to meet the project requirements".

Based on these constructs the following sections explore and present findings from literature on to what extent project management has been discussed in DfS literature and how it can help addressing the commonly faced challenges in DfS implementation.

2. Research Method

As the topics of DfS and project management are quite diverse, the study explores both topics in a two stage literature review method, as illustrated in Figure 1.

The two stage analysis was opted for, as it helped in providing a streamlined overview of the state-of-the art of both project management (PM) and design for sustainability (DfS) in relation to each other. The second stage analyses these findings to explore the insights and possibilities that can arise when PM is studied and applied to the DfS implementation process.

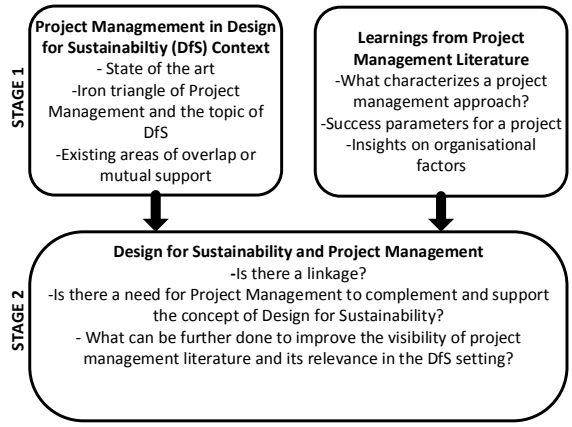

Figure 1 The two stage research model adopted for this paper

The findings from these two stages were then analysed in parallel to drive the discussions presented in the later sections of this article. A literature review on the topic intends to provide a comprehensive understanding of the existing academic research in the area [17], [18].

For streamlining the literature review process, two major databases were selected, namely, ISI Web of Science and Scopus. These selections were made mainly due to two reasons, the detailed meta-data available from these databases that facilitated supplementary research (1) and the relevance of design for sustainability literature in these databases (2). Literature review was carried out based on a wide ranging choice of terms and areas, such as 'project management', 'change management' 'project control', 'design for sustainability', 'eco-design', 'method', 'tool' etc. Section 3 presents the findings from the literature review, followed by discussion on the findings in section 4.

3. Results of the literature review

3.1. Stage 1: Design for sustainability and project management in each other's context

While there is abundant literature on both DfS and PM separately, there appears to be little research that builds on insights from both fields simultaneously. The exploratory research on articles dealing with both topics returned only 52 articles in ISI Web of Science, while Scopus search gave a list of 67 articles. On further applying filters and eliminating the same articles in both the databases, the list was shortened to 32.

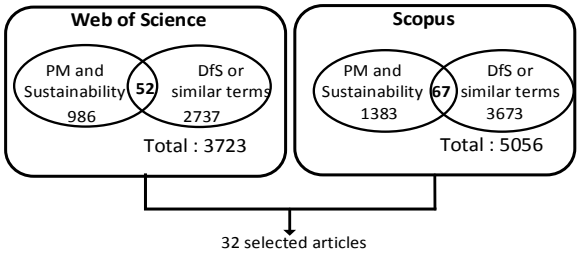

Figure 2 Literature search results in selected databases

The first part of stage 1 analysis looks into the project management literature to identify and highlight features from project management processes, organizational parameters and success factors that can augment and refine the DfS context. Project management literature is vast and addresses a multitude of issues pertaining to projects within organisations. However, as mentioned above, this section of analysis restricts itself to areas in project management literature that the authors believe are relevant in the DfS implementation context. For example, project management research on project success factors, impact of organisational diversities on project execution and managing these diversities, different processes in implementation stages of projects etc.

A wide range of project management literature identifies the three basic success factors for any project, namely, cost, time and quality [19], [20]. Known as the iron triangle, it evaluates how successful the project has been in achieving the stated quality within the budgeted cost and estimated time. But to arrive at this evaluation stage, a project passes through different processes. The Project Management Body of Knowledge (PMBoK) identifies five different processes that needs to be carried out simultaneously for swift information flow between various stakeholders of the project and to meet the overall project requirements. They are:

1. Initiating process group: The process group that define a new project or a new phase of the existing project by obtaining necessary authorization.

2. Planning process group: These process groups define the scope of the project, refine the objectives and decide the course of action for achieving these objectives.
3. Executing process group: This process group include the activities performed to achieve the goals stated in the project plan.
4. Monitoring and controlling process group: Those groups that monitor, regulate and review the project activity.
5. Closing process group: The final process group entails steps taken to close all the activities associated with all process groups to formally end the project or phase [20].

These processes streamline the transition from conception of the product/project to the final delivery and feedback loop involved in it. These do not occur in isolation and thus interact with each other. Especially, the penultimate process group of "monitoring and controlling process" stresses upon the need for knowledge transfer between the organizational stakeholders and different departments in order to facilitate similar projects in the future.

Learning from completed projects is a vital element even in the DfS context. Boks and Stevels [21] mention this as one of the main reasons why an environmental benchmarking tool was developed by Philips, as most environmental design issues were often addressed in isolation from the day to day to business. Schindler and Eppler [22] identifies a series of success factors to gain lessons learned from the debriefing phase of projects. The list includes continuous and regular capture of important project experiences, presence of an external/ neutral moderator for the final debriefing session, a collective and interactive evaluation and analysis of experiences from individual members, among others.

Further, successful transfer of knowledge is not possible as long as the cultural and soft side context of the receiver is not taken into consideration. Boks [13] highlights the importance of 'soft side' parameters in the eco-design context, which include factors such as social and psychological aspects of individuals, lack of commitment and unwillingness to cooperate among other organizational complexities. The literature review on project management literature also identified certain discussions on the role of human-related organizational parameters in successfully realising project goals. For example, in its definition of project management, the Project Management Institute (PMI) identifies human resource management as one of the six fundamental functions of project management [20]. Belout and Gauvreau [23] observe that project personnel have a considerable effect on the success of the projects and hence need to be taken into consideration while deciding upon the staffing process in projects. The PMBoK draws out a 4 stage process for human resource management in projects. These processes range from defining the project scope for each individual involved to the competence required to develop and manage the project team.

A crucial factor in successfully controlling the soft side of project teams is to educate and create a consensus among the people involved on the expected outcomes of the project and the ways to achieve it. A few of the tools and techniques identified for this purpose are as follows [20]:

- Organisation chart and position description
- Networking and team building activities
- Co-location of employees involved
- Recognition and awards for performances
- Continuous and regular conflict management
- Project performance appraisals
- Observation and conversation
- Issue logs

Thus, the project management literature has a great potential in contributing to the expanding field of DfS from both theoretical and practical perspectives. These insights on the systematic approaches in PM literature and their possible contributions to DfS is discussed in the following sections.

The second part of stage 1 analysis reviews how scientific research on project management has been featured in a DfS context. Though articles exclusively on this are very few, a general observation in these shortlisted articles is that emphasis on the triple success factor of project management, i.e time, cost and quality are rarely addressed from a DfS perspective. So is the case with execution phase of eco-design projects. As observed from similar case studies by Brones et al. [10] and Wu and Pheng Low [24], literature on DfS focuses mainly on the technical issues, models and frameworks and little on issues related to managing the process itself.

However, Santolaria et al. [25] observe that in reality, DfS calls for continuous improvement and innovation rather than incremental changes to products to remain valid and to deliver the desired results. The product innovation process, as discussed in the literature, rather reflects a chaotic circular model instead of the conventional linear model of product development [26]. Buijs [26] argues that product innovation can be visualized as a continuous process with neither a fixed ending nor beginning, thus validating the importance of project management in DfS.

Further, case studies carried out on the integration of DfS to the product development process (PDP) in various industries, suggest that the concept of integrated thinking between various stakeholders and parameters in the DfS field is important for real transformation of design practices [27]–[29]. Tingström et al. [30] demonstrate how the integration of the sustainability thinking in project management practices enabled ABB, a large Swedish company in energy and automation, in successfully improving the environmental performance of their products. A general trend in the DfS literature has been the numerous tools, methods and frameworks aimed at facilitating the application of both technical and managerial practices associated with DfS. Pigosso et al. [31] identify 126 different tools in the literature. However, most of these tools are seldom used in a systematic manner by companies, thus failing to deliver the desired results [1]. This provides a rationale for investigating on upto what extent project management elements have been embedded in these tools. This can act as a precursor for understanding how project management elements can be integrated with some degree of feasibility.

A good number of reviews and analyses on eco-design tools have been presented by the academia [27], [32]–[35]. Most of the reviews have analysed the usability, functionality and depth of results these tools present. A general observation from these reviews is that project management elements or processes are either entirely missing or lack focus in these tools. This may primarily be the case because the targeted users of these tools have been mostly designers, without focus on others involved in the product development process and the management thereof.

Most of these tools were made for standalone purposes and thus are void of elements intended to include these tools in the daily business processes. Eco-design tools such as PILOT by Wimmer et al. [36], Environmental benchmarking an internal tool by Philips, EIME (Environmental Information and Management Explorer) provided by CODDE are some that were meant to be integrated in daily businesses. The environmental benchmarking, for example, was developed in order to overcome the shortcomings in resolving environmental issues related to design as isolated projects. The main weakness being the lack of follow up of executed projects and transfer of knowledge acquired from it [21]. Though some elements of project management literature can be found in these eco-design tools, they lack the depth on project execution processes and focus on organizational factors explained earlier in this stage. A few other widely discussed tools such as the MET Matrix, Ten Golden rules and LiDS wheels are mostly checklists or guidelines aimed at highlighting the important factors that designers need to consider when addressing eco-design issues [34], [37]. This excludes the execution phase of such eco-design initiative from its scope. Thus, it is judicious to conclude that research on DfS has to a great extent excluded the importance of project management in sustainability implementation processes.

3.2. Stage 2 : Design for sustainability and project management – Interlinkage, need and possibility

The second stage of analysis covered the need for interlinkage between DfS and PM. The aim of this stage was to identify the likely possibilities that literature on PM has to offer in order to overcome the various challenges and barriers faced by the DfS concept. Though it is difficult to analyse and present a comprehensive list of barriers and challenges in the DfS context, the following section summarizes some of the major challenges that can be addressed by learnings from the PM literature.

One of the most discussed barriers to successful implementation of DfS is the lack of proper communication flow between various stakeholders involved in the process. Boks [13] opines that the most important obstacles found in the literature are about two-way communication and cooperation, and not the success factors enumerated during the top-down process of determining success of DfS implementation. The methods for more effective communication and stakeholder integration is a deeply studied topic in the project management literature. In their article on greening project management practices Robichaud and Anantatmula [38] observe that the charrettes have great potential in facilitating dialogue among the stakeholders and also in highlighting the interest of all the concerned partners right from the beginning of a sustainability focussed project.

Waage [39] argues that another main challenge with DfS is the difficulty in material coordination and right material selection. The difficulties are mainly two-fold, firstly due to the inadequate, inappropriate or unverified information on the environmental performance of many materials [34], [40], [41]. Secondly, most sustainability initiatives according to Waage [39] are devoid of the larger picture where the impact accumulates due to multiple units of the same product. Academic research on project management scenarios involving various interest groups and impact areas elucidate a number of methods and frameworks to map and analyse the impact of a project activity on various stakeholders. Based on a survey carried out among various project managers in Norway, Karlsen [42] proposes six steps that would help in identifying and understanding different impacts from the project at different stages of execution. Olander [43] and El-Gohary et al. [44] also elucidate similar case study examples on coordination in the project management milieu.

Cultural diversity existing within and among organisations and firms has been often identified as a challenge in realizing the goals set during sustainability implementation [13], [45]. In an exploratory study covering people from 53 geographic areas, Hofstede [46] explains how different national cultures impact project management and how cross-cultural sensitivity helps in exploring the benefits of diversity. Further, researchers have studied how an understanding of national cultures (identified by Hofstede and further) impacted various project management scenarios [47], [48]. Findings from such studies can contribute to the ongoing discourse on the role of cultural diversity in sustainability implementation.

In a review on various dimensions of the concept of eco-design, Karlsson and Luttropp [49] observe that the primary aim of eco-design initiatives needs to be eco-effective products rather than eco-efficient ones. Karlsson and Luttropp also opine that market priorities, lifestyle preferences and immaterial aspects of the product being designed are fundamental challenges that need to be addressed [49]. Exploring a similar dilemma in project portfolio selection, Archer and Ghasemzadeh [50] proposes a framework which involves multiple stages directed towards streamlining various parameters that determine project portfolios. This multi-stage framework stresses upon factors that are not entirely product related, but also relate to market forces, individual preferences based on resource availability etc. A few other researchers also discuss similar frameworks and methods on project portfolio selections that can address similar challenges in sustainability implementation [51]–[53]. Further, the project management processes identified in stage 1 of this article also put forward a number of methods to overcome these organisational challenges identified in DfS in a systematic and project based manner.

In a distinct take on the potential of change management in the DfS discussion, Verhulst et al. [54] point out the potential of using the change management concept in eco-design product development as an aid to overcome many human related barriers. Verhulst et al. [54] also present four propositions

connecting the obstacles faced in eco-design literature and constructs in change management literature. Firstly, the gap experienced between the proponents and executors of sustainability strategies can be addressed by theory on organisational resistance. The second proposition is on how effective communication strategies can mitigate lack of cooperation among different individuals and departments in a firm. The third proposition explores how the lack of commitment among individuals in sustainability implementation can be addressed by steps based on theory of organisational resistance. The final proposition deals with cultural differences and states that these differences can be explained by understanding the varying perspectives at the organisational level.

This section presented some of the widely experienced challenges in DfS implementation and how insights from project management literature enable in tackling these challenges.

4. Limitations and discussion

The results from the literature review show that project management has seldom been focused upon in the DfS discourse. On the contrary, the project management literature reviewed present insightful views on addressing various issues commonly faced in DfS implementation. The PM process groups mentioned in the article is an example on how to approach any eco-design project in a systematic manner. Stakeholder management has been another pertaining issue in sustainability implementation. Project management literature presented in this paper also discusses on how various stakeholders involved in a project can be used effectively to deliver the desired goals.

Another major point of intersection between DfS and PM is the methods and needs for addressing human or organizational related factors in eco-design projects. A sample list of tools and techniques prescribed in the project management literature has been presented in the article. The authors believe that as DfS becomes more project based, soft side parameters as highlighted by Boks [13]; and Verhulst et al. [45] have an increasing importance in industrial implementation of DfS. Thereby, a knowledge of these PM tools will aid the discussions on soft side parameters in DfS implementation.

The discussion presented on the barriers faced by DfS and solutions from project management literature reveals the complimentary nature of DfS and PM. This is all the more important as several researchers support the view that barriers to DfS implementation are mostly individualistic and company specific [45], [55], which is also the case with project management practices. These observations indeed present an interesting field of research for further study on intersection between PM and DfS.

A limitation in this exploratory study could be the research methodology used. This methodology was adopted mainly due to the broad nature of the topics that were discussed. As mentioned earlier, academic work addressing both PM and DfS together is scarce and narrowing down the scope of the article was a challenge that the authors faced in the initial stages of analysis. However, the authors are of the view that an in-depth reading of both project management and DfS literature in tandem will greatly enrich and enhance the ongoing research on sustainability implementation.

5. Conclusion and future work

Based on existing literature, this article carried out an exploratory literature review on the role and presence of project management literature in the DfS context. The study was carried out in a two stage process, in which stage 1 examined the state of the art linkage between project management and DfS, and stage two analysed the need and possibilities arising from an interlinkage between the two.

The major scientific contribution by this article has been two-fold. Firstly, as argued upon in the earlier sections of this article, the study reveals a clear missing linkage between PM and DfS. Secondly, focus on PM holds great potential for the field of DfS, especially from the latter's focus on organizational parameters and human side factors in realizing successful projects. Thus, these highlight the possible interconnections between two topics that have been, to a large extent, studied by the academia in singularity. The article thereby sets a stage for further study and discussion in the academic circles on the importance of incorporating project management approach in DfS research.

Future work on the topic can include extensive field studies to identify, analyse and develop a structured overview of overlap between PM and DfS. From an academic perspective, it could be of particular interest to document how project management helps in tackling various implementation barriers faced by companies involved in DfS initiatives.

References

[1] H. Baumann, F. Boons, and A. Bragd, 'Mapping the green product development field: engineering, policy and business perspectives', *J. Clean. Prod.*, vol. 10, no. 5, pp. 409–425, 2002.

[2] N. Bey, C. Boks, M. Ernzer, W. Wimmer, and T. C. McAloone, 'Towards the actual implementation of ecodesign in industry - the `haves` and `needs` viewed by the European ecodesign community', *Proc. CARE Innov. 2002 Fourth Int. Symp. Eco-Effic. Drive Sustain. Concepts Electron. Automot. Ind.*, 2002.

[3] H. C. Zhang, T. C. Kuo, H. Lu, and S. H. Huang, 'Environmentally conscious design and manufacturing: a state-of-the-art survey', *J. Manuf. Syst.*, vol. 16, no. 5, pp. 352–371, 1997.

[4] T. McAloone, N. Bey, Danmark, and Miljøstyrelsen, *Environmental improvement through product development: a guide*. [Environmental Protection Agency], 2009.

[5] D. C. A. Pigosso and H. Rozenfeld, 'Proposal of an Ecodesign Maturity Model: supporting Companies to improve Environmental Sustainability', in *Glocalized Solutions for Sustainability in Manufacturing*, J. Hesselbach and C. Herrmann, Eds. Berlin, Heidelberg: Springer Berlin Heidelberg, 2011, pp. 136–141.

[6] N. Bey, M. Z. Hauschild, and T. C. McAloone, 'Drivers and barriers for implementation of environmental strategies in manufacturing companies', *CIRP Ann. - Manuf. Technol.*, vol. 62, no. 1, pp. 43–46, 2013.

[7] E. Manzini, 'Strategic design for sustainability: towards a new mix of products and services', in *Environmentally Conscious Design and Inverse Manufacturing, 1999. Proceedings. EcoDesign '99: First International Symposium On*, 1999, pp. 434–437.

[8] Glenn Johansson, 'Success factors for integration of ecodesign in

product development: A review of state of the art', *Environ. Manag. Health*, vol. 13, no. 1, pp. 98–107, Mar. 2002.
[9] C. van Hemel and J. Cramer, 'Barriers and stimuli for ecodesign in SMEs', *J. Clean. Prod.*, vol. 10, no. 5, pp. 439–453, Oct. 2002.
[10] F. Brones, M. M. de Carvalho, and E. de Senzi Zancul, 'Ecodesign in project management: a missing link for the integration of sustainability in product development?', *J. Clean. Prod.*, vol. 80, pp. 106–118, Oct. 2014.
[11] F. Brones and M. Monteiro De Carvalho, 'From 50 to 1: Integrating literature toward a systemic ecodesign model', *J. Clean. Prod.*, vol. 96, pp. 44–47, 2015.
[12] A. M. Fet, D. Margrethe Aspen, and H. Ellingsen, 'Systems engineering as a holistic approach to life cycledesigns', *Ocean Eng.*, vol. 62, pp. 1–9, Apr. 2013.
[13] C. Boks, 'The soft side of ecodesign', *J. Clean. Prod.*, vol. 14, no. 15–16, pp. 1346–1356, 2006.
[14] E. Verhulst and C. Boks, 'The role of human factors in the adoption of sustainable design criteria in business: evidence from Belgian and Dutch case studies', *Int. J. Innov. Sustain. Dev.*, vol. 6, no. 2, pp. 146–163, Jan. 2012.
[15] H. Brezet, C. Van Hemel, H. Böttcher, R. Clarke, U. N. E. P. I. and E. (Paris), R. I. (# T. Hague), and D. U. of T. (Delft), *Ecodesign: a promising approach to sustainable production and consumption*. UNEP, 1997.
[16] C. Labuschagne and A. C. Brent, 'Sustainable Project Life Cycle Management: the need to integrate life cycles in the manufacturing sector', *Int. J. Proj. Manag.*, vol. 23, no. 2, pp. 159–168, Feb. 2005.
[17] M. Denscombe, *The good research guide: for small-scale social research projects*. Open University Press, 2014.
[18] R. K. Yin, *Case Study Research: Design and Methods*. SAGE, 2009.
[19] R. Atkinson, 'Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria', *Int. J. Proj. Manag.*, vol. 17, no. 6, pp. 337–342, 1999.
[20] A. Guide, 'Project Management Body of Knowledge (PMBOK® GUIDE)', *Proj. Manag. Inst.*, 2001.
[21] C. Boks and A. Stevels, 'Theory and practice of environmental benchmarking in a major consumer electronics company', *Benchmarking*, vol. 10, no. 2, pp. 120–135, 2003.
[22] M. Schindler and M. J. Eppler, 'Harvesting project knowledge: a review of project learning methods and success factors', *Int. J. Proj. Manag.*, vol. 21, no. 3, pp. 219–228, 2003.
[23] A. Belout and C. Gauvreau, 'Factors influencing project success: the impact of human resource management', *Int. J. Proj. Manag.*, vol. 22, no. 1, pp. 1–11, Jan. 2004.
[24] P. Wu and S. Pheng Low, 'Project Management and Green Buildings: Lessons from the Rating Systems', *J. Prof. Issues Eng. Educ. Pract.*, vol. 136, no. 2, pp. 64–70, 2010.
[25] M. Santolaria, J. Oliver-Solà, C. M. Gasol, T. Morales-Pinzón, and J. Rieradevall, 'Eco-design in innovation driven companies: perception, predictions and the main drivers of integration. The Spanish example', *J. Clean. Prod.*, vol. 19, no. 12, pp. 1315–1323, Aug. 2011.
[26] J. Buijs, 'Modelling Product Innovation Processes, from Linear Logic to Circular Chaos', *Creat. Innov. Manag.*, vol. 12, no. 2, pp. 76–93, Jun. 2003.
[27] P. Knight and J. O. Jenkins, 'Adopting and applying eco-design techniques: a practitioners perspective', *J. Clean. Prod.*, vol. 17, no. 5, pp. 549–558, Mar. 2009.
[28] W. G. Reed and E. B. Gordon, 'Integrated design and building process: what research and methodologies are needed?', *Build. Res. Inf.*, vol. 28, no. 5–6, pp. 325–337, Sep. 2000.
[29] J. Tingström and R. Karlsson, 'The relationship between environmental analyses and the dialogue process in product development', *J. Clean. Prod.*, vol. 14, no. 15–16, pp. 1409–1419, 2006.
[30] J. Tingström, L. Swanström, and R. Karlsson, 'Sustainability management in product development projects – the ABB experience', *J. Clean. Prod.*, vol. 14, no. 15–16, pp. 1377–1385, 2006.
[31] D. C. A. Pigosso, H. Rozenfeld, and T. C. McAloone, 'Ecodesign maturity model: a management framework to support ecodesign implementation into manufacturing companies', *J. Clean. Prod.*, vol. 59, pp. 160–173, Nov. 2013.
[32] A. Birch, K. K. B. Hon, and T. Short, 'Structure and output mechanisms in Design for Environment (DfE) tools', *J. Clean. Prod.*, vol. 35, pp. 50–58, Nov. 2012.
[33] M. D. Bovea and V. Pérez-Belis, 'A taxonomy of ecodesign tools for integrating environmental requirements into the product design process', *J. Clean. Prod.*, vol. 20, no. 1, pp. 61–71, Jan. 2012.
[34] S. Byggeth and E. Hochschorner, 'Handling trade-offs in Ecodesign tools for sustainable product development and procurement', *J. Clean. Prod.*, vol. 14, no. 15–16, pp. 1420–1430, 2006.
[35] T. G. Navarro, S. C. Rizo, M. J. B. Ceca, D. C. Ruiz, and others, 'ECODESIGN FUNCTION AND FORM–CLASSIFICATION OF ECODESIGN TOOLS ACCORDING TO THEIR FUNCTIONAL ASPECTS', in *DS 35: Proceedings ICED 05, the 15th International Conference on Engineering Design, Melbourne, Australia, 15.-18.08. 2005*, 2005.
[36] W. Wimmer, H. Ostad-Ahmad-Ghorabi, R. Pamminger, and M. Huber, 'Product innovation through ecodesign', *Int. J. Sustain. Des.*, vol. 1, no. 1, pp. 75–92, 2008.
[37] C. Luttropp and J. Lagerstedt, 'EcoDesign and The Ten Golden Rules: generic advice for merging environmental aspects into product development', *EcoDesign Whats Happen.*, vol. 14, no. 15–16, pp. 1396–1408, 2006.
[38] L. B. Robichaud and V. S. Anantatmula, 'Greening Project Management Practices for Sustainable Construction', *J. Manag. Eng.*, vol. 27, no. 1, pp. 48–57, 2011.
[39] S. A. Waage, 'Re-considering product design: a practical "road-map" for integration of sustainability issues', *J. Clean. Prod.*, vol. 15, no. 7, pp. 638–649, 2007.
[40] S. H. Aschehoug, C. Boks, and S. Støren, 'Environmental information from stakeholders supporting product development', *J. Clean. Prod.*, vol. 31, pp. 1–13, Aug. 2012.
[41] A. Mayyas, A. Qattawi, M. Omar, and D. Shan, 'Design for sustainability in automotive industry: A comprehensive review', *Renew. Sustain. Energy Rev.*, vol. 16, no. 4, pp. 1845–1862, May 2012.
[42] J. T. Karlsen, 'Project Stakeholder Management', *Eng. Manag. J.*, vol. 14, no. 4, pp. 19–24, Dec. 2002.
[43] S. Olander, 'Stakeholder impact analysis in construction project management', *Constr. Manag. Econ.*, vol. 25, no. 3, pp. 277–287, Mar. 2007.
[44] N. M. El-Gohary, H. Osman, and T. E. El-Diraby, 'Stakeholder management for public private partnerships', *Int. J. Proj. Manag.*, vol. 24, no. 7, pp. 595–604, Oct. 2006.
[45] S. Bertels, L. Papania, and D. Papania, 'Embedding sustainability in organizational culture', 2010.
[46] G. Hofstede, 'Cultural dimensions for project management', *Int. J. Proj. Manag.*, vol. 1, no. 1, pp. 41–48, 1983.
[47] K. Rees-Caldwell and A. H. Pinnington, 'National culture differences in project management: Comparing British and Arab project managers' perceptions of different planning areas', *Int. J. Proj. Manag.*, vol. 31, no. 2, pp. 212–227, Feb. 2013.
[48] O. Zwikael, K. Shimizu, and S. Globerson, 'Cultural differences in project management capabilities: A field study', *Int. J. Proj. Manag.*, vol. 23, no. 6, pp. 454–462, Aug. 2005.
[49] R. Karlsson and C. Luttropp, 'EcoDesign: what's happening? An overview of the subject area of EcoDesign and of the papers in this special issue', *J. Clean. Prod.*, vol. 14, no. 15–16, pp. 1291–1298, 2006.
[50] N. P. Archer and F. Ghasemzadeh, 'An integrated framework for project portfolio selection', *Int. J. Proj. Manag.*, vol. 17, no. 4, pp. 207–216, Aug. 1999.
[51] S. Meskendahl, 'The influence of business strategy on project portfolio management and its success — A conceptual framework', *Int. J. Proj. Manag.*, vol. 28, no. 8, pp. 807–817, Dec. 2010.
[52] X. Li, S.-C. Fang, X. Guo, Z. Deng, and J. Qi, 'An extended model for project portfolio selection with project divisibility and interdependency', *J. Syst. Sci. Syst. Eng.*, vol. 25, no. 1, pp. 119–138, Jul. 2015.
[53] B. S. Blichfeldt and P. Eskerod, 'Project portfolio management – There's more to it than what management enacts', *Int. J. Proj. Manag.*, vol. 26, no. 4, pp. 357–365, May 2008.
[54] E. Verhulst, C. Boks, M. Stranger, and H. Masson, 'The human side of ecodesign from the perspective of change management', in *Advances in Life Cycle Engineering for Sustainable Manufacturing Businesses*, Springer, 2007, pp. 107–112.
[55] M. K. Linnenluecke, S. V. Russell, and A. Griffiths, 'Subcultures and sustainability practices: the impact on understanding corporate sustainability', *Bus. Strategy Environ.*, vol. 18, no. 7, pp. 432–452, Nov. 2009.